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The Impact of Ultrasonicator on the Vertical and Horizontal Mixing Profile of Petrol-Bioethanol

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Abstract : Increasing global energy demand as well as air quality concerns have in recent years led to the search for alternative clean fuels to replace fossil fuels. One such alternative is the blending of petrol with ethanol, which has numerous advantages such ethanol's ability to act as oxygenate thus reducing the carbon monoxide emissions from the exhaust of internal combustion engines of vehicles. However, the hygroscopic nature of ethanol is a major concern in obtaining a perfectly homogenized petrol-ethanol fuel. This problem has led to the study of ways of homogenizing the petrol-ethanol mixtures. During the blending process, volumes fraction of ethanol and petrol were studied with respect to the depth within the storage container to confirm homogenization of the blend and time of storage. The results reveal that the density of the mixture was constant. The binodal curve of the ternary diagram shows an increase of homogeneous region, indicating an improved of interaction between water and petrol. The concentration distribution in the reactor showed proof of cavitation formation since in both directions, the variation of concentration with both time and distance was found to be oscillatory. On comparing the profiles in both directions, the concentration gradient, diffusion flux, and energy and diffusion rates were found to be higher in the vertical direction compared to the horizontal direction. It was therefore concluded that ultrasonication creates cavitation in the mixture which enhances mass transfer and mixing of ethanol and petrol. The horizontal direction was found to be the diffusion rate limiting step which proposed that the blender should have a larger height to diameter ratio. It is, however, recommended that further studies be done on the rate-limiting step so as to have actual dimensions of the reactor.

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